



EXECUTIVE SUMMARY

Investigating ecosystem dynamics at a watershed level

A White Paper produced from a conference sponsored by the Soil and Water Conservation Society held in Athens, Georgia, April 13-16, 1997

Jean L. Steiner, Alan J. Franzluebbers, L. Mark Risse, Philip A. Moore, Jr., Charles A. Francis, Joyce Scheyer, Cornelia B. Flora, Rhonda R. Janke, William G. Deutsch, Stephen Gasteyer, Judy A. Tolke, William Upshaw

In the winter of 1995-1996, the Soil and Water Conservation Society established an Issue Survey Task Force to identify natural resource issues that should be addressed and activities that would be appropriate to achieve the Society's mission. One issue identified was that "Improvements are needed in capabilities to identify and to address natural resource management issues in a holistic manner (ecosystem/watershed/whole farm/new partnerships) with an objective of sustain-

Jean L. Steiner, USDA-ARS, Watkinsville, GA; Alan J. Franzluebbers, USDA-ARS, Watkinsville, GA; L. Mark Risse, Agricultural Pollution Prevention Extension Specialist, Univ. of GA; Philip A. Moore, Jr. USDA-ARS, Fayetteville, AK; Charles A. Francis, Center for Sustainable Agriculture, Univ. of Nebraska, Lincoln, NE; Joyce Scheyer, USDA-NRCS, Lincoln, NE; Cornelia B. Flora, North Central Regional Center for Rural Development, Iowa State Univ., Ames, IA; Rhonda R. Janke, Department of Agronomy, Kansas State Univ., Manhattan, KS; William G. Deutsch, International Center for Aquaculture and Aquatic Environments, Auburn, AL; Stephen Gasteyer, North Central Regional Center for Rural Development, Iowa State Univ., Ames, IA; Judy A. Tolke, USDA-ARS, Bushland, TX; William Upshaw, USDA-NRCS, Athens, GA.

able resource use." The task force recommended that an interdisciplinary cadre of scientists and practitioners be assembled to (i) review what is known about ecosystem dynamics as it relates to the sustainability of soil and water resources, (ii) determine what needs to be understood so that soil and water resources can be effectively managed to sustain ecological integrity while maintaining economic livelihoods, and (iii) develop a white paper for distribution to policy makers and research and education institutions. The staff of the USDA Agricultural Research Service in Watkinsville, GA, proposed to the board of directors to organize and host a conference "Interactions: Investigating Ecosystem Dynamics at a Watershed Level" in collaboration with the Society. The conference goals were to:

- 1) Provide a forum for research scientists, land owners, agricultural advisors, policy makers, and others to discuss issues surrounding the topic "ecosystem dynamics at the watershed level."

- 2) Identify research, information, program, and policy needs at local, regional, national, and international levels to support this approach to land management.

The program included a mix of plenary sessions that highlighted issues to be addressed; poster sessions that gave examples of current projects, approaches to integrated team projects, and findings from diverse environments; facilitated breakout sessions for idea generation and synthesis of issues raised in the plenary and poster sessions; and conference tours that highlighted research, education, and agricultural activities within Southern Piedmont watersheds. Each breakout team included a writing team member who was responsible to capture key ideas and help incorporate those ideas into this white paper. The white paper is an integrated product of all who participated in the conference. Because the conference attracted participants primarily from the USA, that perspective predominates throughout the white paper. Still, the ideas and concepts have relevance to systems in many environments.

The conference was sponsored by the

Soil and Water Conservation Society, and cosponsored by the Soil Science Society of America, USDA Natural Resources Conservation Service (Watershed Science Institute, Grazing Lands Technology Institute, Social Sciences Institute, and Soil Quality Institute), USDA Agricultural Research Service, Tennessee Valley Authority, Cooperative Research Education Extension and Economic Service, Monsanto, US Environmental Protection Agency, Conservation Technology Information Center, Georgia Chapter of the Soil and Water Conservation Society, Univ. of Georgia College of Agricultural and Environmental Sciences, and Oconee County (Georgia) Chamber of Commerce. The financial and organizational support of conference Sponsors is gratefully acknowledged.

Jean L. Steiner, conference organizer

Ecosystem analysis at a watershed level

Healthy ecosystems require that economic, environmental, and social outcomes be adequately addressed, periodically reevaluated, and kept in balance. To develop and manage sustainable landscapes with multiple uses we need systems approaches that address dynamic characteristics of people and their environments as a whole and includes multiple feedback loops as integral to the process.

A watershed provides a practical scale for systems research and management, because boundaries can be defined and participants recognize their interrelatedness with others who share a water supply. It is essential to identify broad-based stakeholders, get them involved early, and maintain an open process so additional stakeholders can become involved. In holistic approaches to management, plans and actions are rooted in stakeholders' values and must address their highest priority goals. Time required to build participation, communication, and trust pays off through efficient solutions to shared problems.

Research needs. Traditionally, animal scientists have studied animals, soil scientists have studied soils, plant scientists have studied plants, limnologists have studied water, atmospheric scientists have studied air; seldom have natural resource scientists collectively studied the whole system. Integration of natural resource with socioeconomic sciences is even rarer. Although we are obtaining increasingly detailed information on components of ecosystems, we need to comprehensively understand the structure of agriculture and effects of management on the entire ecosystem.

Economic theory as a whole is insufficient when dealing with things that have non-monetary value. We need an economic theory that balances (i) the value of ecological services of a watershed, (ii) environmental improvement, (iii) societal/cultural needs, and (iv) the ability to achieve financial goals. Although difficult, analyses that document inputs and outputs across political and watershed boundaries are needed to determine if practices are "good" for society as a whole and to determine types and quantity of incentives that could be provided.

Models provide a way to organize and communicate current understanding of key processes and interactions in a system. We need more complete conceptual and mathematical models that describe watershed processes and support informed decision making by stakeholders, but our understanding and data bases to construct such models are sparse and can only be addressed by comprehensive studies of ecosystem and watershed processes. Baseline data that measure quality of life, environmental quality, and ecosystem health are needed to provide indicators based on outcomes of an investment or action.

Education needs. Information concerning natural resources and ecosystem functions must be addressed to a broad-based community of stakeholders, including non-traditional audiences such as urban and suburban homeowners, the elderly, small businesses, and others. Knowledge needs to be packaged in practical ways such as "best management practices" for households, communities, agricultural lands, and forestry to encourage people to consider change.

We need watershed-level educational programs to provide a critical link between research and application. This should include curricula for (i) lifelong environmental education, (ii) training the trainers on how to motivate a community to action, and (iii) a watershed and

ecosystem focus for K-12 and university students.

Policy needs. Stakeholders of the system being managed should have primary responsibility to define goals and develop policies. While broad national policies for ecosystem protection are needed, successful implementation depends on stakeholders' values that may differ among regions.

Everyone supports ecosystem protection in some way, but individuals differ on points such as who should pay the costs and how much negative economic impact can be tolerated at the expense of ecosystem protection. We need "accounting" systems to compare monetary and non-monetary values, and to balance short-term and long-term economic or ecologic benefits.

Societal response to uncertainty about impacts has been to accept risks of negative impacts that we might be able to get by with. An alternative proposal based on the "precautionary principle" recognizes that there will always be uncertainty in quantifying impacts of pollutants within ecosystems, and that uncertainty should move us, as a society, to act with caution in protecting ecosystem function, rather than risking what we might be able to get by with.

Setting the direction for integrated natural resource systems management. In defining an agenda to support integrated ecosystem and watershed management, it is important to assess (i) what we know and the impacts of what we do; (ii) what we do not know but need to know to develop more sustainable systems; and (iii) what elements are important but inherently unknowable. We know that a factory model of production has caused many problems when applied to agricultural systems and that there are examples of more ecological approaches to farming that have succeeded in all parts of the world. We do not know how to implement and assess environmental quality impacts of agricultural systems using outcome-based, rather than design-based, standards. We will never be able to forecast future societal preferences, surprises, or the future "vision" that will drive agriculture or other production systems. To prepare for the "unknowable", we need strategies for a diversity of possible futures with adaptability to respond to social and environmental surprises.

Broad-based stakeholder involvement. The power of stakeholder involvement is starting to be recognized and institutionalized in agricultural and natural resource management programs. For

emerging problems within ecosystems and watersheds that transcend the agricultural sector, additional stakeholders will need to be brought into the process, representing interests of all impacted by natural resource management. Research and management systems that are designed together should be monitored and evaluated together and stakeholder involvement is required from the outset.

Integrated research, education, and management. A systems approach provides a strategy to cope with ecosystem dynamics within watersheds. Such programs have high start-up costs, particularly in the time involved in establishing a stakeholder network, building trust that allows the group consensus process to succeed, and compiling baseline information. Monitoring impacts of change is also expensive. Concurrent research and education within natural resource management efforts could leverage limited resources for maximum impact and effectiveness. Institutional leaders should develop reward systems that encourage, rather than penalize, risk-taking researchers, educators, and practitioners who act "outside the box."

Hierarchical research programs. Just as ecosystems are hierarchical, there is a need for hierarchical research programs. Shorter-term studies to address different questions can often be embedded within long-term experiments. When the goal is to study the system as a whole, but there is a critical lack of understanding of a particular process within the system, it may be efficient to design a component study within the larger integrated study. A key is to ensure appropriate linkages within hierarchies.

Interagency cooperation and communication. Problems addressed within a watershed exceed the scope and mandate of any single local, state, or federal agency, so communication is needed across societal and agency lines. While many people work hard to achieve cooperation, there is so much information coming from so many different places that a systematic approach is needed to enhance quick and complete communication about diverse activities within a given watershed.

For a copy of the full text of this white paper contact the Soil and Water Conservation Society, 7515 NE Ankeny Road, Ankeny, Iowa 50021-9764, attention Charlie Persinger.